

Purpose: To investigate the feasibility of breast tissue composition in terms of water, lipid and protein with a Cadmium-Zinc-Telluride (CZT) based computed tomography system, as that information may help to better characterize suspicious lesions.

Methods: Simulations and experimental studies were performed with a spectral CT system equipped with a CZT-based photon counting detector with energy resolution. Simulations of the figure-of-merit (FOM), which represents the signal-to-noise ratio (SNR) of the dual energy image with respect to mean glandular dose, were performed to find the optimal configuration of experimental acquisition parameters. A calibration phantom of 3.175 cm in diameter was constructed from a polyoxymethylene plastic with cylindrical holes and filled with water and oil. Similar size samples of pure adipose and lean bovine tissue were used for the three-material decomposition. Tissue composition results computed from the images were compared to data from chemical analysis of prior tissue samples.

Results: The beam energy was selected to be 100 kVp with a threshold energy of 40 keV. The tissue samples were successfully decomposed into water, lipid and protein contents. The RMS percentage errors of the mass density for the three-material decomposition, as compared to data from chemical analysis, were estimated to be approximately 6.92%.

Conclusion: The results of this study suggest that the CZT-based photon counting detector may be employed in the CT system to quantify the water, lipid, and protein mass densities in tissue with relatively good agreement.